GUIDELINES AND BACKGROUND FOR THE CONTROL OF INDUSTRIAL WASTE EMISSIONS TO THE AIR, WATER AND LAND FROM TERMINAL GRAIN ELEVATORS

January, 1977

Ontario

Ministry of the Environment

The Honourable
George A. Kerr, Q.C.,
Minister

Everett Biggs,
Deputy Minister

ONTARIO MINISTRY OF THE ENVIRONMENT

GUIDELINES AND BACKGROUND FOR THE CONTROL OF INDUSTRIAL WASTE EMISSIONS TO THE AIR, WATER AND LAND FROM TERMINAL GRAIN ELEVATORS

January, 1977

TERMINAL GRAIN ELEVATORS

Table of Contents

STATEMENT OF INTENT

The primary purpose of these guidelines is to assist Ministry staff in the execution of abatement and approvals functions. They may also be used by industry as an indication of environmental control requirements.

These guidelines are supplementary to the "Guidelines and Criteria for Water Quality Management in Ontario", the "Objectives for the Control of Industrial Wastes Discharges in Ontario", and the requirements of The Environmental Protection Act pertaining to the emission of air contaminants and the disposal of solid wastes. Details of Provincial noise control requirements are embodied in The Model Municipal Noise Control By-Law and its supporting technical publications which contain acceptable noise level limits applicable to industrial activity.

The guidelines reflect overall Ministry policy. They should be applied recognizing specific requirements of individual sites, alternate process and abatement technology, and the need to stage programs which will achieve the Ministry's goals in a rapid but realistic manner.

INTRODUCTION

It is intended that these guidelines should apply to all new and existing terminal grain elevators, in order to encourage adoption of uniform pollution control methods throughout the province. It is recognized that a number of terminal elevators have already installed satisfactory control equipment and others have made commitments to do the same via programs approved by the Ministry.

Terminal elevators are distinguished from country grain and feed elevators by their function, size and location. Country elevators, located inland, will transport grain to a terminal elevator which, in Ontario, will invariably be situated at a waterfront location in order that products may be unloaded into ships. In addition, terminal elevators can handle grain at the rate of 30,000 bushels per hour or more, as opposed to the country elevator which is usually limited to less than 2,000 bushels per hour. Terminal elevators also dry, clean and process grain to various specifications.

Specific reference should be made to:

(a) The Environmental Protection Act, 1971, Section 5, and Regulation 15 of the Revised Regulations of Ontario, 1970, Section 5 and Schedule 1, Item 33 (dustfall) and Item 73 (suspended particulate matter);

(b) The Objectives for the Control of Industrial Waste Discharges in Ontario (wastewater), particularly 5-day Biochemical Oxygen Demand (BOD_5) and Suspended Solids; and

(c) The Environmental Protection Act, 1971, Section 14 (1) (c); Regulation 15, Section 6 (a), (b) and (c) (with respect to sound and vibration emissions); the Model Municipal Noise Control By-Law, parts of which may be adopted by the municipality concerned and the publication "Guidelines for Approvals for Potential Noise Sources".

A. A I R

1. Receiving

The quantity of air freely expelled from the receiving hopper during unloading of grain from rail cars or trucks should be reduced as much as possible. Some methods to accomplish this are by the use of louvres under the grate, which open under the weight of the grain; by the use of "choke unloading" (where possible), i.e., using a smaller receiving hopper to increase the ratio of grain to air within the hopper; or the use of hopper-type rail cars.

The receiving area should be enclosed by a shed to help reduce wind currents. If possible, one door at the end of the enclosure should be closed.

Particulate collected by hooding near the rail car openings and by under-grate hopper aspiration should be ducted to a dust collection system.

2. Transferring, Conveying, etc.

Dust created at every location during the operations of transferring and conveying of grain throughout the terminal elevator should be aspirated and vented to a dust collection system.

3. Screening and Cleaning

The fine particles from pneumatic classification which are usually removed in a cyclone separator should also be vented to a dust collection system. In addition, all point sources within the workhouse should be vented through the dust collection system.

4. Loading

Trucks and rail cars should be loaded within an enclosure or shed to reduce the effects of wind currents. If possible, one door at the end of the enclosure should be closed. Telescopic or fabric shrouded loading spouts should be employed to decrease the distance that the grain must free fall through the air.

For the loading of ships, telescoping spouts should be used. These should reach near the bottom of the hold so

that the end of the spout is quickly buried in the pile of grain. The area of the hatch opening should be made as small as possible by partially closing the hatch cover or using tarpaulins, etc.

New methods involving aspiration at the loading spout or hatch opening should be investigated.

5. Grain Dryers

The light, fluffy particulate known as "red dog" or "beeswings", emitted during the drying of corn, should be controlled as much as possible by the use of fabric screens or other filters.

Other fine particulate from the drying of corn and other grains remains a problem. An additional guideline, covering grain dryers, will be issued following results of the study currently being performed at the University of Guelph.

6. Handling of Collected Dust

Grain dust from dust collecting equipment should be handled and transported in a manner which will prevent such dust from becoming windborne. Trucks and other conveyances should be covered.

If possible, grain dust should be pneumatically conveyed to pelletizing equipment. Pelletizing equipment, which can also be a dust source, should have aspiration to a dust collection system.

7. Calculation of Impingement Concentrations

It is recommended that stack sampling be performed to determine actual emission rates. If necessary, the concentration of particulate matter at a point of impringement may be calculated by using the following emission rates for uncontrolled sources and by using estimated reductions for sources with fabric filters. <u>The current Ministry standard for particulate matter is 100 micrograms per cubic metre of air over a one-half hour period</u>.

TABLE OF EMISSION RATES FOR CALCULATING IMPINGEMENT CONCENTRATIONS

Source (without treatment)	Range of Emissions (lb/ton of grain processed)
Shipping or Receiving - Rail	1 - 3
- Truck	0.8 - 3.5
Transferring, conveying etc.	2 - 2.5
Screening and Cleaning	5 - 7
Grain Drying	4 - 8

Source (with cyclones)	Emissions (lb/ton of grain processed)
Shipping or Receiving	0.025 - 0.038
Transferring	0.036
Cleaning	0.25
Bin Vents	0.036

The data in the tables above were taken from a U.S. Environmental Protection Agency study and an industry stack sampling survey conducted in Thunder Bay.

Sampling methods and procedures should be performed in accordance with the Ontario Ministry of the Environment's "Source Testing Code".

B. W A T E R

Liquid industrial wastes arising from operations at a terminal grain elevator may contain high levels of BOD_5 and suspended solids. Any such effluents should not be discharged directly to a watercourse or storm sewer.

Liquid industrial wastes which do not meet Ministry objectives for discharge to a watercourse or storm sewer should be discharged to a municipal sanitary sewer, if available, or to private treatment facilities which have been approved by the Ministry. The current objectives for the concentrations of BOD_5 and suspended solids are 15 mg/l.

C. SOLID WASTE

Solid waste material which cannot be reused or recycled, must be disposed of in a satisfactory manner which usually means some type of landfilling operation. When the company itself intends to operate the landfill site, a Certificate of Approval must be obtained from the Ministry of the Environment. If the waste is to be hauled to a municipally owned disposal site, approval by the municipality involved is required.

Any plans for solid waste disposal should be discussed initially with the Industrial Abatement Section of the District Office of the Ministry. Applications for approval are available from that office.

Spilled grain or grain dust should be cleaned up as soon as possible so that it does not become a source of water or air pollution. In general, a supervised program of good housekeeping should be maintained throughout the facilities of the terminal grain elevator.

D. N O I S E

1. Existing elevators should meet the noise level specified by the municipality's land useage plan, noise control by-law and/or the Provincial noise guidelines.

2. New elevators proposed in a municipality within or near a residential area should meet the proposed 45 dBA equivalent sound level (Leq) at the receiver during the night.

3. Elevators operating in essentially rural areas may be required to exercise more stringent noise controls during the night because of very low ambient noise levels.

4. Fans for dust collection systems and air movement in general should be selected with a view to low noise characteristics.

BACKGROUND TO

GUIDELINES FOR TERMINAL GRAIN ELEVATORS

A terminal grain elevator can receive grain at the rate of 30,000 to 60,000 bushels per hour. Every operation to which the grain is subjected while at the elevator creates dust. If the emission of this dust to the atmosphere is not controlled the effects of these emissions will be detected in the immediate vicinity of the terminal elevator and/or many miles distant, depending on the prevailing atmospheric conditions.

Environmental problems related to the operations at a terminal grain elevator include the nuisance of dustfall on residential properties and automobiles, health effects such as allergic reactions of the skin and/or respiratory system, water pollution due to industrial wastes and spillage into the watercourse, land disposal of waste dust from collection systems and noise from processing equipment.

TERMINAL ELEVATOR OPERATIONS

This section will describe the various operations which are carried out at a typical termina grain elevator, the sources of dust emissions and methods to reduce or control dust from these operations.

Receiving

Most of the grain is received at the terminal elevator in railroad boxcars or hopper cars. Boxcars are unloaded over the receiving hopper using "power shovels" or by mechanically tilting the car. Hopper cars discharge the grain directly from the bottom of the car into the receiving hopper below. The operation of unloading produces a considerable amount of dust. The use of hopper cars results in a somewhat smaller dust emission than from boxcars.

Dust emissions from this operation are difficult to capture since the construction of hooding near the rail car openings is complex. However, this control method can be effective and should be investigated.

The receiving area should be enclosed by a shed to reduce wind currents as much as possible. If possible, one door at the end of the enclosure should be closed. The installation of air curtains should be investigated. When

both doors are left open, a wind tunnel effect is often created, reducing the benefit of the enclosure.

Other methods of reducing dust emissions from the receiving area are outlined below:

- Self-closing louvres which open under the weight of the grain can be installed under the grate of the receiving hopper to reduce the size of the opening.

- the use of "choke unloading" (a smaller receiving hopper) where possible. Since the hopper fills faster, the grain does not fall as far and comes into contact with a smaller quantity of air.

- undergrate aspiration which is connected to a dust collection system.

The comments above also apply to receiving areas where grain is unloaded from trucks.

Transferring, Conveying, etc.

Grain from the receiving hopper is conveyed to the bottom of the receiving leg and lifted in a bucket elevator to the top of the terminal building. There, grain passes through the garner, scale and surge bins (for weighing, etc.) and is distributed to the appropriate storage bin via a tripper on the gallery conveyor belt.

When the grain is to be shipped, it is removed from the bottom of the storage bins onto a conveyor belt in the basement of the building, to a bucket elevator, lifted to garner scale and surge bins (for final weighing) and thence to the shipping conveyor and loading spout.

Dust is created at each location and during each operation mentioned above. Some methods of reducing particulate emissions from these operations are outlined below:

- provide aspiration at the points where dust is created and vent to a dust collection system.

- use covered conveyors and grain moving systems.

- intervent the garner, scale and surge bins.

- intervent the up and down leg of the bucket elevator.

- intervent two or more storage bins (as permitted by insurance regulations).

- pressurization of the basement should be investigated, especially for a new building.

Screening and Cleaning

These operations are performed in an area of the terminal elevator called the "workhouse", and include mechanical screening and cleaning as well as pneumatic classification. In this latter operation the lighter waste components of the grain are carried away in a large volume of air and are removed from the air stream in a cyclone separator. Emissions to the atmosphere from this operation constitute one of the largest single sources of particulate from the terminal elevator. The fine dust which passes through the cyclone should be vented to a dust collection system.

The air within the workhouse is usually quite dusty. Point sources in this area should be vented through the dust collection system. In a new installation, consideration should be given to pressurizing this area.

Emissions from these operations will be quite variable and depend upon the cleanliness of the grain received and the type of processing equipment used.

Loading

The problems of dust emissions occurring during loading of ships, rail cars and trucks are similar to those arising at the receiving area. Rail cars and trucks should be loaded within an enclosure or shed to help reduce the effects on wind currents. Telescoping or fabric shrouded loading spouts will decrease the distance that the grain must free fall through the air.

The control of dust during ship loading represents a unique problem due to the remote location of the dock, the size of the vessel and the varied configurations of loading hatches and deck surfaces. Without resorting to the use of special hooding, special hatch covers and a separate dust collection system, dust emissions may be reduced by the use of telescoping loading spouts which reach near the bottom of the hold so that the end of the spout is quickly buried in the pile of grain. In addition, the size of the hatch opening should be made as small as possible by partially

closing the hatch cover or using tarpaulins, etc. Other types of cargo compartments which require a "slinger" to fill remote corners have a more difficult dust control problem.

Another method of dust control during the loading operation which might be investigated involves the installation of a secondary vent pipe next to the feed discharge pipe. This would aspirate airborne dust to a dust collection system.

Grain Dryers

The purpose of the grain dryer is to reduce the moisture content of the grain to prevent problems during storage. Generally, air is heated and brought into contact with the grain in a cocurrent, concurrent or cross-flow arrangement. A cool down period follows the heating cycle.

When the dryer is in operation, the resultant emissions of particulate matter to the atmosphere are the second greatest of any source at the elevator. The operating period of the dryer is quite variable and depends on the quantity and moisture content of the incoming grain. The moisture laden air discharges from the typical dryer via a very large surface area. In addition, the high concentration of water vapour in the effluent gasses requires the use of a special fabric filter which is costly.

The drying of corn poses a special problem due to the emission of a light fluffy particle known as "red dog" or "bees wings". The use of special filters or fabric screening has been suggested to help alleviate this problem.

A separate guideline covering grain dryers will be issued at a later date following the completion of a study currently being performed at the University of Guelph.

Characteristics of Grain Dust

The grain transported to the terminal elevator may contain fine particles, such as soil, sand, minerals and pollen which are freed from the grain during the various operations performed at the elevator. In addition, other dust is composed of grain hairs and fractured grain particles.

The particles appear in many shapes, and their sizes vary from less than one micron to about 50 microns. Beeswings, although 5,000 microns long and 50 microns thick, are very light and easily carried on air currents. (25,400 microns equal 1 inch).

Dust Control Equipment

Wet scrubbers and electrostatic precipitators are normally efficient dust collection facilities, but have certain inherent problems which preclude their use in grain elevators. Wet scrubbers require the use of large volumes of water as well as extensive sludge removal facilities. Electrostatic precipitators are not used here because of the explosive nature of grain dust.

Cyclone separators have been used at terminal elevators for many years as a means of dust control. However, even the most efficient cyclones do not remove particles smaller than 10 - 20 microns in size. Cyclones can be ratained for pre-treatment ahead of a more efficient collector to remove heavy dust loadings consisting of large sized particles.

A fabric filter collector (baghouse) is capable of removing dust particles down to sub-micron size, with an efficiency greater than 99%. It is recommended that this type of air cleaning facility be used at terminal grain elevators.

Baghouses may be classified according to the type of cleaning mechanism employed. The "shaker" type raps or shakes the support which suspends the bags, loosening the collected dust which falls into a hopper. A woven cloth is used, and the cleaning cycle is repeated at predetermined intervals. Shaker baghouses require a low air : cloth ratio and occupy quite a large space. The reverse air baghouse uses a felted cloth and is cleaned with a flow or blast of air at short intervals, without the necessity of shutting down a portion of the filter units. A higher air to cloth ratio may be used, with the result that the units occupy a smaller space. At the time this document was written there did not appear to be a clear-cut advantage or performance indication for the use of either the shaker or reverse air baghouse, since both have been employed successfully to control emissions of grain dust.

The installation of a centralized modular baghouse should be considered. Such a facility has the following advantages over localized units:

- the capital cost is comparable with localized units.

- there should be lower operating costs (power) due to lower pressure drop requirements.

- when one or more contributing dust sources are shut down, the total volume of air filtered is less, reducing wear on the fabric.

- the handling of the collected dust is simplified.

- a centralized filter will usually be constructed in several modules, facilitating inspections and maintenance since one section may be shut down at any time.

However, dust sources which are located remote from a centralized facility and requiring the use of very long runs of ductwork, may dictate the need for individual, localized fabric filters.

Grain dust accumulated from dust collectors is often manufactured into pellets which are used for animal feed. If possible, the grain dust should be pneumatically conveyed to the pelletizing plant. If trucks are used, they should be covered and care should be exercised to ensure that dust does not become windborne during the transfer operations. The movement of waste dust for any purpose should be carefully supervised.

It can be seen that there are numerous ways to prevent or reduce environmental pollution from terminal grain elevators. Ministry policy requires that discharges and emissions meet the current standards and objectives. In the case of air quality, the standard at a point of impingement for particulate matter is 100 micrograms per cubic metre of air over a one-half hour period. In the case of water, the individual concentrations of BOD_5 and suspended solids should not exceed 15 milligrams per litre in a discharge to a watercourse or storm sewer.* The information set out in the background report illustrates some methods by which Ministry requirements can be achieved.

As newer and better control methods are introduced, they should be investigated fully by the industry and employed where they are applicable.

* For a more complete listing of Ministry standards and objectives, please refer to the documents outline in the introduction.